MERRIMACK RIVER BASIN
MEREDITH, NEW HAMPSHIRE

LAKE WAUKEWAN DAM
NH 00306

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS, 02154

OCTOBER 1978

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Merrimack River Basin
Meredith New Hampshire
Man made outlet between Lake Waukewan and Lake Winnipesaukee

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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FORM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

407-440

REPLY TO
ATTENTION OF:
NEDED

OCT 12 1979

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Lake Waukewan Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Amatex Corporation.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

LAKE WAUKEWAN DAM
NH 00306

MERRIMACK RIVER BASIN
MEREDITH, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Lake Waukewan Dam, I.D. NH 00306
State Located:	New Hampshire
County Located:	Belknap
Town Located:	Meredith
Stream:	Man made outlet between Lake Waukewan and Lake Winnipesaukee
Date of Inspection:	June 6, 1978

BRIEF ASSESSMENT

Lake Waukewan Dam is a man-made outlet facility between Lake Waukewan and Lake Winnipesaukee. The facility, a surge and outlet structure has a total overflow weir length of only 11.25 feet with a permanent crest elevation of 1.80 feet below the nominal lake level.

The physical condition of the facility is fair as a result of a modification completed in 1976. It is to be noted that there is no dam or impounding structure associated with this facility. Lake Waukewan Dam has created an additional outlet between Lake Waukewan and Lake Winnipesaukee; however, the original natural outlet has fallen into disuse and has been effectively blocked, so that at present all hydraulic conveyance is through Lake Waukewan Dam. The only provisions for emergency spillage is through the regulating weir, which has very limited capacity. The project has approximately 4 feet of surcharge storage capacity equivalent to 4 in. of runoff or about 20 percent of Probable Maximum Flood Volume (PMF), the recommended test flood for this project. Lake inflows in excess of storage capacity could overtop the lake rim and flood streets of Meredith. Further hydrologic studies are required to establish the need for, and means, of providing an emergency spillway.

Recommended actions to be carried out by the owner, within 12 months after receipt of this Phase I Report, are summarized in Section 7. The most important of these is the acquisition of sufficient data to produce a comprehensive set of drawings for the facility from its inlet canal to the outlet channel into Lake Winnipesaukee. Foundation conditions along the waterway are to be determined in conjunction with this task. A further study to augment the existing hydraulic conveyance capacity between Lake Waukewan and Lake Winnipesaukee is recommended.

Robert Gershowitz, P.E.

This Phase I Inspection Report on Lake Waukewan Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe condition be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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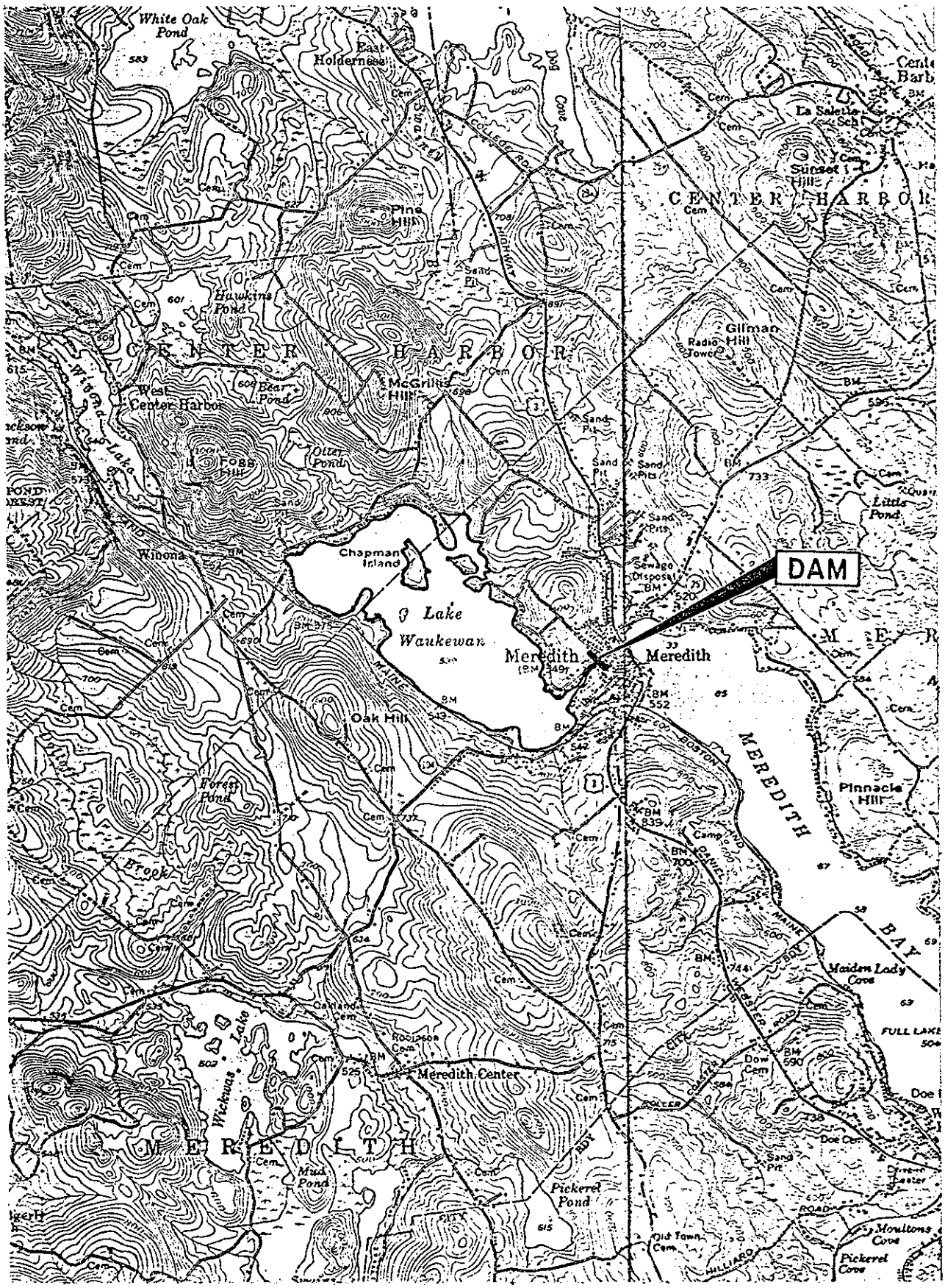
View of the surge and overflow structure in the Amatex Corporation parking area



Quadrangle: Holderness, N.H.
Scale : 1 : 62,500

VICINITY MAP

PHASE I INSPECTION REPORT

LAKE WAUKEWAN DAM NH 00306

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. HARRIS-ECI ASSOCIATES has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to HARRIS-ECI ASSOCIATES under a letter of June 7, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0305 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Project Description

a. Location

Lake Waukewan Dam is located on the grounds of the Amatex Corp. in the Town of Meredith, Belknap County, New Hampsire. The facility is located between Lake Waukewan and Lake Winnipesaukee, east of Main Street and North of Dover Street. Lake Waukewan is a tributary to Lake Winnipesaukee and part of the Merrimack River primary drainage basin.

b. Description of Dam and Appurtenances

Lake Waukewan Dam is a man-made outlet facility between Lake Waukewan and Lake Winnipesaukee that was used formerly for power generation but has not been used for that purpose since 1954. There is no actual dam or impounding structure connected with the facility; instead Lake Waukewan, a natural lake, was used as the reservoir. No plans or drawings are on file for any part of this facility. Reference is made to Drawing 2 which shows the schematic layout of the scheme as made on the visual inspection. The natural outlet of Lake Waukewan is Corliss Brook but its outlet channel has been effectively blocked by a road and other parts of its natural channel have been filled by private interests, apparently with the tacit approval of the Town.

The present facility was constructed in 1904 and consists of an intake canal approximately 700-foot long and about 20-foot wide running from Lake Waukewan to a point some 60 feet west of Main Street. At this point, a concrete culvert said to be 6 x 6 feet in dimension connects the water to 6-foot diameter steel conduit and from there to a surge and overflow structure. Flow in the conduit and penstock can be shut-off by means of a manually operated timber sluice gate. The surge and overflow structure was used as the inlet to the penstock of a hydraulic turbine and served as a surge overflow facility at load rejection and as the regulating weir controlling the level of Lake

Waukewan when power was not being generated. The penstock inlet was walled off in 1976 when the surge and overflow structure was remodeled to increase its overflow capacity. As of now the total overflow weir length is only 11.25-foot long with a permanent crest elevation of 1.80 feet below the nominal lake level of Elevation 539.0.

The surge and outlet structure is located on Amatex Corporation property and discharges into an outlet channel. The channel runs down a steep hillside alongside and below adjacent Amatex mill buildings, discharging into Lake Winnipesaukee some 200 feet to the east of and 35 feet below the surge and outlet structure. There are no other buildings nearby or affected by the outlet channel.

Lake Waukewan has a surface area of 947 acres and impounds 20,540 acre-feet of water derived from a tributary drainage area of 12.54 square miles.

c. Size Classification

According to the "Recommended Guidelines of the Safety Inspection" by U.S. Department of the Army, Office of the Chief of Engineers, the facility is classified in the size category as being "Intermediate" since its storage is more than 1,000 acre-feet, but less than 50,000 acre-feet. Since there is no dam, its size is not classifiable in the usual manner. The overall size classification is based on the storage capacity alone, and accordingly the facility is classified as being "Intermediate" in size.

d. Hazard Classification

The facility has been classified as having a High Hazard Potential in the Inventory of Dams compiled by U.S. Army Corps of Engineers on the basis that excessive damage could occur to downstream property in the

event of failure of the facility and its appurtenances, together with the possibility of losing more than a few lives. This inspection concurs with the assessment on the basis that the facility impounds a very large volume of water, and that at present Lake Waukewan has its natural outlet blocked off, and relies solely on the artificial outlet created by the former power waterway to regulate lake levels. The outlet capacity of the Amatex Corporation waterway is very inadequate to accommodate and pass along flood inflows into Lake Waukewan and could pose a threat to downstream mill property and to mill employee's life in case of a very large storm inflow event.

e. Ownership

Lake Waukewan Dam is owned by the Amatex Corporation of Meredith, New Hampshire.

f. Operator

Lake Waukewan Dam is operated by the Amatex Corporation, Daniel Webster Highway, Meredith, New Hampshire.

g. Purpose of Dam

The facility at present is only used to regulate the level of Lake Waukewan although in former times, up to 1954, it was used to generate power for mill operation purposes.

h. Design and Construction History

No records exist for the design and construction history. The facility was built in 1904, according to available documentation, and was used for the next 50 years for mill power generation. Lake level regulation was incidental to power generation and the various mill owners undertook this task as part of their normal operations. In 1954, the power generation at the site ceased, but the regulation of the lake level has continued by the mill owner. As a result of the active regulation of

the lake by the various mill owners, the natural outlet of Lake Waukewan fell into disuse and the conveyance capacity of its natural channel has been seriously impaired by the construction of a town road crossing its channel at the lake rim and by filling operations along its channel length by a lumber company. As a result, the natural outlet, called Corliss Brook has no significant capacity to pass flood water inflows from Lake Waukewan to Lake Winnipesaukee, and the entire hydraulic conveyance capacity between both lakes is now at Lake Waukewan Dam. After power generation ceased, the power penstock flow was no longer available as part of the hydraulic conveyance, and accordingly the N.H. Water Resources Board (NH-WRB) ordered the owner to increase the capacity of the overflow weir section. The reconstruction of the surge and overflow structure was completed in 1976. The main feature of this work was to lower permanent overflow crest by 18 in. and the relining of the interior of the structure with a reinforced concrete wall which permanently blocked off the power pennstock.

i. Normal Operating Procedures

At present, the level of Lake Waukewan is being regulated by the Amatex Corporation by means of stop planks in the surge and overflow structure. The normal lake level is being maintained at Elev. 539± in the summer time,and 15 to 22 inches lower in the winter time, corresponding to 3 stop planks in place at the outlet structure weir in the summer time and zero to one stop planks in the winter.

1.3 Pertinent Data

a. Drainage Area — 12.54 square miles

b. Discharge at Dam Site

Maximum known flood at dam site:	(Volume unknown, occurred on 7/4/78. (Lake level rose 3 ft. above normal.
Warm water outlet at pool elevations:	NA
Diversion tunnel low pool outlet at pool elevation:	NA
Diversion tunnel outlet at pool elevation:	NA
Gated spillway capacity at pool elevation:	NA
Gated spillway capacity at maximum pool elevation:	NA
Ungated spillway capacity at maximum pool elevation:	530 cfs, all stop planks removed
Total spillway capacity at maximum pool elevation:	530 cfs, all stop planks removed

c. Elevation (Feet above MSL)

Top of dam:	Not applicable, no dam exists. Minimum lake rim level estimated at 543.08
Maximum pool design surcharge:	Elev. 543.08
Full flood control pool:	NA
Recreation pool:	Elev. 539
Spillway crest:	(Permanent crest 537.20 of overflow (structure
Upstream portal invert diversion tunnel:	NA
Downstream at centerline diversion tunnel:	NA
Streambed at centerline of dam:	NA
Maximum tailwater:	Normal level of Lake Winnipesaukee Elev. 504.0

d. Reservoir

Length of maximum pool:	2.76 miles
Length of recreation pool:	2.76 miles
Length of flood control pool:	NA

e. Storage (acre-feet)

Recreation pool:	20,542
Flood control pool:	NA
Design surcharge:	24,500
Top of dam:	NA

f. Reservoir Surface (acres)

Top of dam:	NA
Maximum pool:	1,003 (Elev. 543.0)
Flood control pool:	NA
Recreation pool:	947 (Elev. 539.0)
Spillway crest:	947 (Elev. 539.0)

g. Dam

Type:	No dam exists at the site, the former power waterway is used presently for lake level regulation
Length:	
Height:	
Top width:	
Side Slopes - Upstream:	
- Downstream:	
Zoning:	
Impervious core:	
Cutoff:	
Grout curtain:	

h. Diversion and Regulating Tunnel

Type:	NA
Length:	NA
Closure:	NA
Access:	NA
Regulating facilities:	NA

i. Spillway

Type:	Surge overflow structure
Length of weir:	11.25 feet
Crest elevation:	537.20 permanent concrete crest plus 4 flashboards, each 7 1/2 in. high
Gates:	None
U.S. Channel:	6-foot diameter penstock
D/S Channel:	Outlet chute channel, masonry construction

j. Regulating Outlets

Low level outlet:	None
Controls:	None
Emergency gate:	Timber sluice gate in power waterway, manually operated under balanced head conditions
Outlet:	6-foot diameter penstock

SECTION 2

ENGINEERING DATA

2.1 Design

There are no plans for any part of this facility, whether for parts built originally in 1904 or sections reconstructed in 1976. A reconnaissance sketch of the schematic layout of the facility is shown on Drawing 2. There is no design information available on the subsurface conditions along the outlet water waterway.

No information is available on the hydraulic capacity of the rebuilt surge and overflow structure as it stands today, although computations for a previously considered modification are in the files of N.H. Water Resources Board (NH-WRB).

No information is available for the hydrologic basis of the original power waterway design and the lake level regulation capability of that design.

No information is available on the structural design of the various components of the facility. The location of interface between the concrete conduit and the steel penstock cannot be identified in the field. The exact location and dimensions of the power waterway cannot be verified from any documented source or any physical evidence on the ground.

2.2 Construction

No data of any kind has been recovered on the construction of the facility.

2.3 Operation

No data has been recovered on the operation of the facility insofar as regulation of the lake level. The lake level has risen to approx. 3 ft. above its nominal level in 1933, 1936 and 1973. The 1973 event apparently was the most severe, in that outflows from the surge and overflow structure weir overtopped the small retaining wall at the top of the chute outlet channel and threatened to undermine the foundations of the adjacent Amatex mill buildings as well as the outlet structure itself and its outlet chute channel.

2.4 Evaluation

a. Availability

Engineering data and documentation of the physical features of Lake Waukewan Dam are virtually non-existent. A program of data acquisition and documentation is required.

b. Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based on visual inspection, past performance history and sound engineering judgment.

c. Validity

Available data in the form of inspection reports and dam records in the files of the NH-WRB are inconsistent and need to be reassessed and evaluated against an actual record set of as-built drawings and details.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General

Lake Waukewan Dam is in fair physical condition after a rehabilitation completed in 1976. Although a significant part of the waterway could not be inspection due to prevailing head water conditions, the operable portions, such as the sluice gate and stop planks appeared to be in acceptable working condition.

b. Dam

There is no dam associated with this facility.

c. Appurtenances (refer to Drawing 2)

The appurtenant structures that make up the waterway of this facility are:

(1) The intake canal intake structure and intake culvert section.

(2) The penstock section including the sluice gate house.

(3) The surge and overflow structure.

(4) The outlet chute channel.

Intake Structure and Intake Culvert Section. The intake structure is at the end of a 700-ft. long intake channel which is approx. 20-ft. wide and 6.5-foot deep. The channel is apparently man made and leads off a narrow bay of Lake Waukewan adjacent to Water Street. The intake canal

at places was lined with brush and trees, but the vegetation probably does not affect its hydraulic conveyance capacity. At the end of the canal, some 60 feet east of Main Street, a concrete intake structure has been built. The intake is a widened section of the intake culvert, and the mouth of the intake is guarded by a wooden trash screen with bars spaced about 6 inches on centers vertically. The intake leads to a concrete culvert said to be 6 feet by 6 feet in dimension which could not be inspected. This concrete culvert passes under the building fronting on the west side of Main Street, and then crosses Main Street itself. The condition of the conduit is deteriorated according to town officials interviewed during the inspection, and is thought to be the source of leakage water within the bed of Main Street. On the west side of Main Street, the concrete conduit is terminated at an undefined point and the waterway continues in a 6-foot diameter metal penstock pipe.

Penstock Pipe. No part of the penstock pipe was visible or accessible for inspection since it runs underground at an undefined location. The general path of the pipe is westward toward the Amatex Corp. plant. In the parking lot of the Amatex Corp. a gate house has been built, housing a timber gate whose function is to cut off the water flow in the penstock for the maintenance of downstream portions. The gate is not considered an emergency structure, since it cannot be quickly lowered against flowing water. The invert of the waterway is believed to be approximately 8 feet below the top of the ground at the gate house.

The gate itself is constructed of timber and has two 8 in. x 12 in. timber gate stems. Both stems are used in raising or lowering the gate. Each stem has a cast iron rack spiked to it. These racks are driven by two pinion gears which are both keyed to the same shaft. On each end of the shaft, there is a hub with a number of sockets into which

a lever can be placed. Two men, one at each hub, operate the gate. In addition, there is a ratchet and pawl at each end of the pinion shaft which can be used to lock the gate in any desired position.

There is a one-foot diameter shear gate installed on the upstream face of the sluice gate. This shear gate is used to flood the downstream portion of the penstock pipe leading to the stop log structure after dewatering for maintenance. In this manner, the differential head across the sluice gate is eliminated and the effort required to raise the gate is reduced. The gate appeared to be in satisfactory operating condition, having been rebuilt in 1976.

The gate house walls are of reinforced concrete construction. No leakage water or wet ground conditions were observed at the gate house structure. The gate house superstructure was of wood construction with siding and has a conventional roof covered with asphaltic sheet roofing material. The gate house was in acceptable condition.

Surge and Overflow Structure. The waterway reach between the gate house and the overflow structure is also a buried 6-foot diameter steel penstock according to information received from the owner's representatives. This reach was not visible or accesible for inspection. No traces of ground seepage could be detected visually that could be attributed to the pipe. The surge and overflow structure is of concrete construction and used to serve as a surge facility during turbine load rejection, and as an overflow facility when the turbine was shutdown or when inflows exceeded turbine's water demand. The concrete structure was relined on the inside with a 15-inch facing layer of concrete during the 1976 rehabilitation of the facility. The inside resurfacing has permanently blocked off the 6-foot diameter power penstock leading to the hydraulic turbine at the mill. Some of the outside surfaces of the surge and overflow structure are in a cracked and deteriorated condition, but no immediate corrective action is required at this time since the inside surfaces have been relined.

At the same time as the relining work was completed, the permanent spillway crest was lowered to a point 1.5 feet below the normal level of Lake Waukewan, and a three bay stop plank section was added above the permanent crest. The stop log planks are supported by steel angle supports at the wall ends, and by intermediate structural steel beams in between. The vertical steel beams are in very good condition. The stop planks are also considered in good condition although some planks deflected visibly under the water pressure. No action is required now, but if the deflection becomes sufficient to cause significant leakage between planks, the planks should be replaced.

At the time of the inspection, three stop log planks were in place in each of the three bays, and 6 inches of water was flowing over the top of the planks. The loss of head in the waterway from the intake to the stop planks was estimated at one inch.

Outlet Channel Chute. The water passing over the stop planks of the surge and overflow structure passes into a narrow chute channel that drops steeply down a hillside slope. The channel is variously pitched and has drops of several feet between sections. The construction is mainly masonry walls and masonry or grouted stone bottom, but there are concrete paved and formed sections as well. The entire drop is estimated at 35 feet. At the bottom of the slope, the outlet channel is widened to accommodate the turbine tailrace. The widened channel passes under an Amatex mill building and U.S. Route 3 in a concrete culvert before entering Lake Winnipesaukee, the receiving body. The chute wall adjacent to the surge and overflow structure was rebuilt and raised in the 1976 reconstruction to prevent a spillover condition at high discharges that threatened the safety of the Amatex building during the 1973 flood event.

The entire chute channel and walls are in acceptable condition; however, the hydraulic performance during high flow conditions cannot be evaluated due to lack of configuration data.

Geologic Setting. The entire waterway facility is believed to be founded on either a bouldery ground moraine or granite bedrock. No exposures of subsurface material occur in Meredith adjacent to the facility.

d. Reservoir

The reservoir rim is generally flat to moderately sloping for the first 5 to 6 feet above the full lake level and moderately sloping above that. The lake rim is naturally wooded, with local clearings where summer cottages or residences have been constructed. No signs of reservoir rim instability could be visually detected.

e. Downstream Channel

The downstream channel is a very short open channel leading from the culvert exit on the west side of U.S. Route 3 to Lake Winnipesaukee. There are no obstructions or residences in this reach.

3.2 Evaluation

The overall physical condition of the facility is judged fair for the portion that could be visually inspected. The intake culvert and steel penstock could not be inspected and no evaluation of their condition is possible. The owner should review his records and files of the 1976 reconstruction for possible condition reports of these structures or obtain reliable eyewitness statements from personnel present at that time.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

Lake Waukewan Dam is currently operated solely for the purpose of regulating the level of Lake Waukewan. The regulation of the lake is carried out by the personnel of the Amatex Corporation, the owners of the facility. The facility is not the natural outlet of Lake Waukewan. The natural outlet of Lake Waukewan is Corliss Brook, located one half mile south of the Lake Waukewan Dam near the intersection of Waukewan Street and Railroad Avenue. The channel of Corliss Brook has been partially blocked by the reconstruction of Waukewan Avenue in 1922. Downstream parts of the natural brook channel have been filled in by a lumber company. As a result, the natural outlet plays no role in regulating Lake Waukewan surface levels or in conveying water from Lake Waukewan to Lake Winnipesaukee, the receiving body.

The level of Lake Waukewan is maintained at or near Elevation 539.0 in the summer months and the lake is drawn down 22 to 30 inches below the summer level in the winter months to minimize ice damage and to provide storage for spring-time snowmelt inflows.

4.2 Maintenance of the Dam

Maintenance of the facility is carried out on an as-needed basis by personnel of the Amatex Corporation.

4.3 Maintenance of Operating Facilities

At the time of inspection, the facility appeared to be adequately maintained. The trash rack at the inlet was free of debris, the sluice

gate was adequately protected inside the gate house and the outlet channel chute was free of obstructions and debris. Maintenance is provided on an as-needed basis by the owner.

4.4 Description of any Warning System in Effect

There is no warning system in effect. The outlet channel chute is on the property of the Amatex Corporation, in the immediate vicinity of the facility. The only property not belonging to Amatex is the short reach of the outlet culvert under U.S. Route 3 and the short connecting channel to Lake Winnipesaukee.

4.5 Evaluation

The operational procedures at the facility are simple fitting in with the simple facilities involved. In line with greater public interest in dam safety, the owner should institute a bi-annual dam inspection utilizing a simplified version of the visual check list used in this inspection report. The reports should be kept on permanent file. Maintenance schedules should be drawn up and all visits to the facility should be logged in a permanent record, whether for maintenance or operation.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The evaluation of the hydraulic and hydrologic features of Lake Waukewan Dam was based on criteria set forth in the Corps' Guidelines for Phase I inspections, and additional guidance provided by the New England Division, Corps of Engineers. The Probabe Maximum Flood (PMF) was estimated from guide curves for probable maximum flood for New England region, based on past Corps' studies. The PMF peak versus drainage area curves are presented in the section of hydrologic computations.

The PMF curve applicable for rolling areas was adopted for the estimation of the PMF peak of the reservoir. The PMF versus drainage area relationship can be expressed mathematically as follows:

$$Q = 2323 - 676.99 \log_{10} A$$

$$Qp = Q \times A$$

where:

Q = Unit peak discharge in cfs, square miles

Qp = Peak PMF discharge, in cfs, for the watershed of the dam

A = Watershed area, in square miles, upstream of the dam axis.

The computed peak discharge of the PMF for a drainage area of 12.54 square miles using the above equation is 19,806 cfs. A triangular shaped flood hydrograph was assumed for the inflow design hydrograph.

The PMF inflow hydrograph was routed through the reservoir by the modified Puls Method, utilizing computer program HEC-1. The peak outflow discharge for the PMF is 9,796 cfs. The PMF results in overtopping of the lake rim.

The overtop discharge rating curve was developed by assuming an overflow section 300-foot long with a top elevation of 543.08. This corresponds physically to the intake canal bank reach upstream of the intake structure. The canal bank would overflow and discharge lake water into Main Street at times of high levels caused by large lake inflows. There could also be other lake rim reaches where lake water might overflow such as at the natural outlet in the vicinity of Railroad Avenue. No detailed survey information was available to delineate other potential natural overflow areas along the lake rim.

The reservoir stage-capacity curve was constructed using comparisons of both dam inventory data and planimetered areas, measured from 15 minute quadrangle topography maps. Reservoir storage capacity included surcharge levels exceeding the rim of the lake at the intake canal. In the routing computations, the discharge through outlet facilities was excluded on the basis that its capacity was insignificant in comparison with the PMF. The overtop discharge rating curve and the reservoir capacity curve are presented in the section of hydrologic computations.

b. Experience Data

The most recent severe rainstorm occurred on July 4, 1973, and raised the lake level 3 feet above normal, not enough to top the banks of the intake canal. At that time, the surge and overflow structure permanent crest was 18 inches above its present level, and the resulting large

flow out of the surge and overflow structure jumped over the training wall of the outlet chute channel and started to erode the hillside adjacent to the Amatex mill buildings. The flow was brought under control by sandbagging the area around the surge and overflow structure and re-training the flow toward the outlet channel. Other high flow events occurred in 1933 and 1936 according to records in the files of the NH-WRB.

c. Visual Observations

The spillway outlet channel is very narrow with relatively low masonry walls. The hydraulic capacity and energy dissipation properties cannot be assessed without a detailed profile along its length. The intake canal rim can act as an auxiliary spillway, routing lake flows into and down Main Street adjacent to it. The hydraulic capacity of the surge and overflow structure is very limited and the intake structure could be subject to clogging at critical times.

d. Overtopping Potential

As indicated in Section 5.1.a., the PMF, when routed through Lake Waukewan results in overtopping of the lake rim at the intake canal surcharge capacities are too small to accommodate the peak flow. The PMF overtopped the lake rim by 4.9 feet. This figure is indicative only and must be modified on the basis of a more accurate survey of reaches of the lake rim subject to overtopping during high lake levels. According to the Recommended Guidelines for Inspection of Dams by the Corps of Engineers, the lake should have an outlet capable of handling the PMF. The question of whether the outlet capacity should be at the Lake Waukewan Dam facility owned by Amatex Corporation or at the formal natural outlet at Corliss Brook cannot be answered within the scope of this investigation. At present the Lake Waukewan has inadequate outlet discharge capacity. The existing surge and overflow structure has a capacity of approximately 5 percent of the PMF before overtopping of the lake rim occurs.

No dam break calculations were performed since there is no artificial impounding structure associated with the facility.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The present condition of the facility suggests a stable structure to all outward appearances. Allegations that the intake culvert is leaking could not be verified visually, and should be further investigated if strong evidence of leakage is present. The outlet channel chute has a very limited waterway cross section and could be subject to overtopping and undermining during large lake outflows. This channel, however, has withstood all flows since the facility was opened for operation in 1904. It should be noted that the 1976 reconstruction markedly increases the possible flows in this channel, and its stability and hydraulic action should be reviewed together.

b. Design and Construction Data

No design or construction data was uncovered that would permit the evaluation of stability of the facility.

c. Operating Records

Even though the facility is changed from the configuration standing during the 1973 flood, the performance at that time casts some doubts on the ability of the surge and overflow structureto survive a PMF event. Questionable conditions relate to the foundation of the surge and overflow structure and its possible loss due to progressive slope erosion downhill of the structure.

d. Post Construction Changes

The 1976 rehabilitation improved the ability of the facility to prevent lake rim overtopping during medium frequency storm events. The modification of the surge and overflow structure increased the conveyance capacity of the entire waterway to make up for the loss of conveyance by the permanent walling off of the power penstock. The increased discharge capacity of the surge and overflow structure might overtax the hydraulic capacity of the outlet channel chute.

e. Seismic Stability

The dam is located in Seismic Zone 2 and, in accordance with the Recommended Phase I Guidelines, does not warrant seismic analyses.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

The overall physical condition of Waukewan Lake Dam is fair as a result of its modification completed in 1976. The facility has an inadequate outflow capacity amounting to approximately 5 percent of the spillway Design Flood (SDF) for this watershed, which in this case is the Probable Maximum Flood (PMF). The spillway discharge capacity has been estimated by current Corps of Engineers screening criteria, and the owner should determine the spillway capacity by more sophisticated and accurate methods and procedures.

b. Adequacy of Information

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency

The urgency of performing the recommendations and remedial measures are detailed below.

d. Need for Additional Investigations

There is no need for further investigations in this phase of the program. Recommended investigations to be carried out by the owner are listed below.

7.2 Recommendations

It is recommended that the owner, within 12 months after receipt of this Phase I Report, assemble the following information, if the data can be found:

a. Data Acquisition

(1) An updated as-built set of drawings of the facility showing all pertinent details of the complete waterway from the head of the inlet canal to the outlet at Lake Winnipesaukee.

(2) A topographic survey of the overbank area of the inlet canal should be part of the survey. The area around the natural outlet of the lake should also be topographically surveyed. All topographic and condition surveys should be tied into a common U.S.G.S. datum system.

(3) The foundation conditions along the waterway should be determined and depth to bedrock indicated where less than 10-foot deep.

b. Investigations

Determine the spillway capacity of the dam using more sophisticated and accurate methods than were used in the Phase I screening methodology employed in this report. These studies should include the routing of the inflow through the lake, based on the accurate elevation of low lying lake rim areas that could act as overflow sections during high lake levels.

Reevaluate the hydraulic capacity of the outlet chute channel at the Spillway Design Flood (SDF) discharge conditions and reassess the possibility of undermining this part of waterway and the adjacent surge and overflow structure at SDF discharges.

It is also recommended that the owner formulate a plan for conveying the SDF from Lake Waukewan to Lake Winnipesaukee utilizing the Lake Waukewan Dam conveyance, and other possible conveyance routes.

Based on the results of the spillway capacity analyses, the owner should formulate plans for augmenting the Lake Waukewan spillway capacity, if shown necessary.

7.3 Remedial Measures

a. Alternatives

The alternatives available for augmenting the outlet capacity of Lake Waukewan are as follows:

(1) Increase the outlet capacity at Lake Waukewan Dam owned by Amatex Corporation.

(2) Restore the outlet capacity at Corliss Brook.

(3) Develop a new outlet for Lake Waukewan at a third site.

(4) Seasonally lower the level of Lake Waukewan to provide additional storage for large inflows.

(5) Use a combination of all four alternatives listed above.

Based on the final formulated plan for conveyance of the SDF between Lake Waukewan and Lake Winnipesaukee, the owner should review the adequacy of the Lake Waukewan Dam to safely convey its stipulated share of the total flow requirements.

b. O&M Maintenance and Procedures

The owner should initiate the following programs:

(1) A bi-annual inspection of the dam utilizing a visual check list similar to that used in this inspection report.

(2) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

(3) Assemble and keep on hand complete documentation of the dam design, as-built drawings, and any other data pertaining to the dam safety.

(4) The owner should establish a formal system with local officials for warning downstream residents in case of emergency. Round the clock surveillance should be provided by the owner during periods of unusually heavy precipitation.

APPENDIX A

CHECK LISTS:
- VISUAL OBSERVATIONS
- ENGINEERING, CONSTRUCTION MAINTENANCE DATA
- HYDRAULIC AND HYDROLOGIC DATA ENGINEERING DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam LAKE WAUKEWAN DAM County Belknap State New Hampshire Coordinators

Date(s) Inspection June 6, 1978 Weather Sunny Temperature 75°F

Pool Elevation at Time of Inspection 539.6 ± M.S.L. Tailwater at Time of Inspection 504.0± M.S.L.

Inspection Personnel:

Seymour Roth
David Kerkes
Yin Au-Yeung
Lynn Brown
William Flynn

Recorder: Seymour M. Roth

Representing the Owner: Mr. Fred Copp, Amatex Corporation

Also interviewed: Mr. Donald Jutton, Town Manager, Town of Meredith
Mr. Harold Wyatt, Selectman, Town of Meredith

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Note: There is no dam associated with this facility.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	NA	
DRAINS	NA	
WATER PASSAGES	NA	
FOUNDATIONS	NA	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	NA	
STRUCTURAL CRACKING	NA	
VERTICAL & HORIZONTAL ALIGNMENT	NA	
MONOLITH JOINTS	NA	
CONSTRUCTION JOINTS	NA	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NA	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NA	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NA	
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	NA	
RIPRAP FAILURES	NA	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NA	
ANY NOTICEABLE SEEPAGE	NA	
STAFF GAGE AND RECORDER	NA	
DRAINS	NA	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS & RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	1. Some of the exterior surfaces of the surge and spillway shaft are cracked. The interior surfaces have been resurfaced with a layer of reinforced concrete. 2. The surfaces of intake concrete structure are in acceptable condition. 3. Exterior surfaces of the gate house were in acceptable condition 4. The interior surfaces of the gate house and the intake conduit could not be inspected.	No action required.
INTAKE STRUCTURE	The intake structure consists of a widened section of a concrete conduit approximately 6 ft.-6 in. deep by 13.5 ft. wide leading to the 6 x 6 ft. concrete conduit under a house fronting on Main Street. The intake is protected by a wood trash rack with bars arranged vertically on 6 in. centers. The intake structure is at the end of 15-20 ft. wide canal leading in from Lake Waukewan. At a point east of Main Street, the 6 x 6 ft. culvert changes to a 6 ft. diameter penstock pipe. The penstock is controlled by a timber sluice gate. All visible portions of the intake were in acceptable condition.	
OUTLET STRUCTURE (SURGE I OVERFLOW STRUCTURE)	The outlet structure has been relined internally with new concrete but the outside upstream end is cracked. Three stop plank sections control the level of Lake Waukewan. The stop planks and guides are in good condition.	
OUTLET CHANNEL	The outlet channel is very steep and narrow dropping some 35 ft. on about 70 ft. horizontally. The upper part, adjacent to the surge overflow structure is protected by a 4.5 ft. high splash wall. The chute walls are in acceptable condition, constructed of various types of concrete and masonry.	
EMERGENCY GATE	The emergency gate is in the reach between the canal intake and the surge and overflow structure. The gate is of timber construction with a double timber stem. The stems have a cast iron toothed rack bolted to them. The gate is lifted manually be means of of pinch bars and pawls, one tooth at a time. The timber sluice gate and all appurtenances are new and in good working condition.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	NA	
APPROACH CHANNEL	NA	
DISCHARGE CHANNEL	NA	
BRIDGE AND PIERS	NA	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE SILL	NA	
APPROACH CHANNEL	NA	
DISCHARGE CHANNEL	NA	
BRIDGE AND PIERS	NA	
GATES & OPERATION EQUIPMENT	NA	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/ SURVEYS	NA	
OBSERVATION WELLS	NA	
WEIRS	NA	
PIEZOMETERS	NA	
OTHER	NA	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENTATIONS
SLOPES	Lake Waukewan shore line is moderately sloping to flat and wooded except where locally cleared for residences. No instability of the shore line slopes could be detected.	
SEDIMENTATION	Some sedimentation is visible in the inlet canal but not enough to affect hydrological or hydraulic parameters.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Very steep man made channel between surge and overflow structure and Lake Winnipesaukee, the receiving body. Chute bottom is concrete, walls are masonry or concrete. The chute masonry and concrete are in acceptable condition.	
SLOPES	Part of the channel slopes are extremely steep, 1 on 2 vertical.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two Amatex mill buildings are located downstream of the surge and overflow structure; one is alongside the downstream channel, the other over the channel at the bottom of the slope.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available. No dam actually exists.
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available
TYPICAL SECTIONS OF DAM	Not available
HYDROLOGIC/HYDRAULIC DATA	Some available in N.H. Water Resources Board files
OUTLETS - PLAN	Not available
- DETAILS	
- CONSTRAINTS	
- DISCHARGE RATINGS	Data on rebuilt overflow weir capacity is available
RAINFALL / RESERVOIR RECORDS	Some data available in N.H. Water Resources Board files

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	Some outlet weir computations are available
DAM STABILITY	Not available
SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	Not available
LABORATORY	Not available
FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	None performed
BORROW SOURCES	Not applicable
SPILLWAY PLAN - SECTIONS	Not available
- DETAILS	Not available

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	Not available
MONITORING SYSTEMS	None installed
MODIFICATIONS	Surge and outlet structure remodeled in 1975
HIGH POOL RECORDS	Available in N.H. Water Resources Board files
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not made
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	Not available
MAINTENANCE OPERATION RECORDS	None available

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: LAKE WAUKEWAN DAM

Drainage Area Characteristics: 12.54 square miles

Elevation Top Normal Pool (Storage Capacity): 539.0 (20,542)

Elevation Top Flood Control Pool (Storage Capacity): NA

Elevation Maximum Design Pool: 543.0 (2,500)

Elevation Top Dam: No dam exists. Minimum lake rim estimated at Elev. 543

SPILLWAY CREST:

a. Elevation Permanent crest 537.20
b. Type Triple pass stop-plank section
c. Width Approximately 3.5 feet
d. Length 11.3 feet
e. Location Spillover At top of slope Amatex property
f. No. and Type of Gates None

OUTLET WORK:

a. Type NA
b. Location NA
c. Entrance Inverts NA
d. Exit Inverts NA
e. Emergency Draindown Facilities None

HYDROMETEOROLOGICAL GAGES:

a. Type None
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE 220 cfs (estimated)

APPENDIX B

PHOTOGRAPHS

ALL PHOTOGRAPHS TAKEN ON JUNE 6, 1978

Photo 1 - View of Lake Waukewan from the head of the inlet canal.

Photo 2 - End of the intake canal west of Main Street. The trash rack guarding the inlet of the 6 ft. x 6 ft. intake conduit passes under the building in the background and under Main Street, fronting on the building's other side.

Photo 3 - Gate house astride the 6-ft. diameter penstock. The gate inside is of timber construction, and can block off water for downstream maintenance.

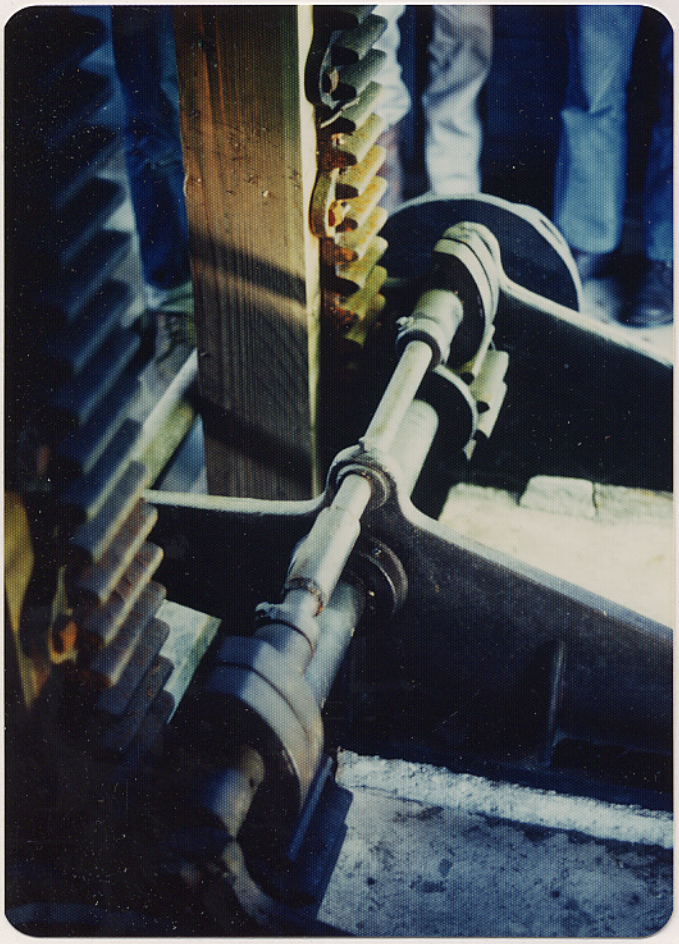


Photo 4 - View of the double stem timber sluice gate lifting mechanism.

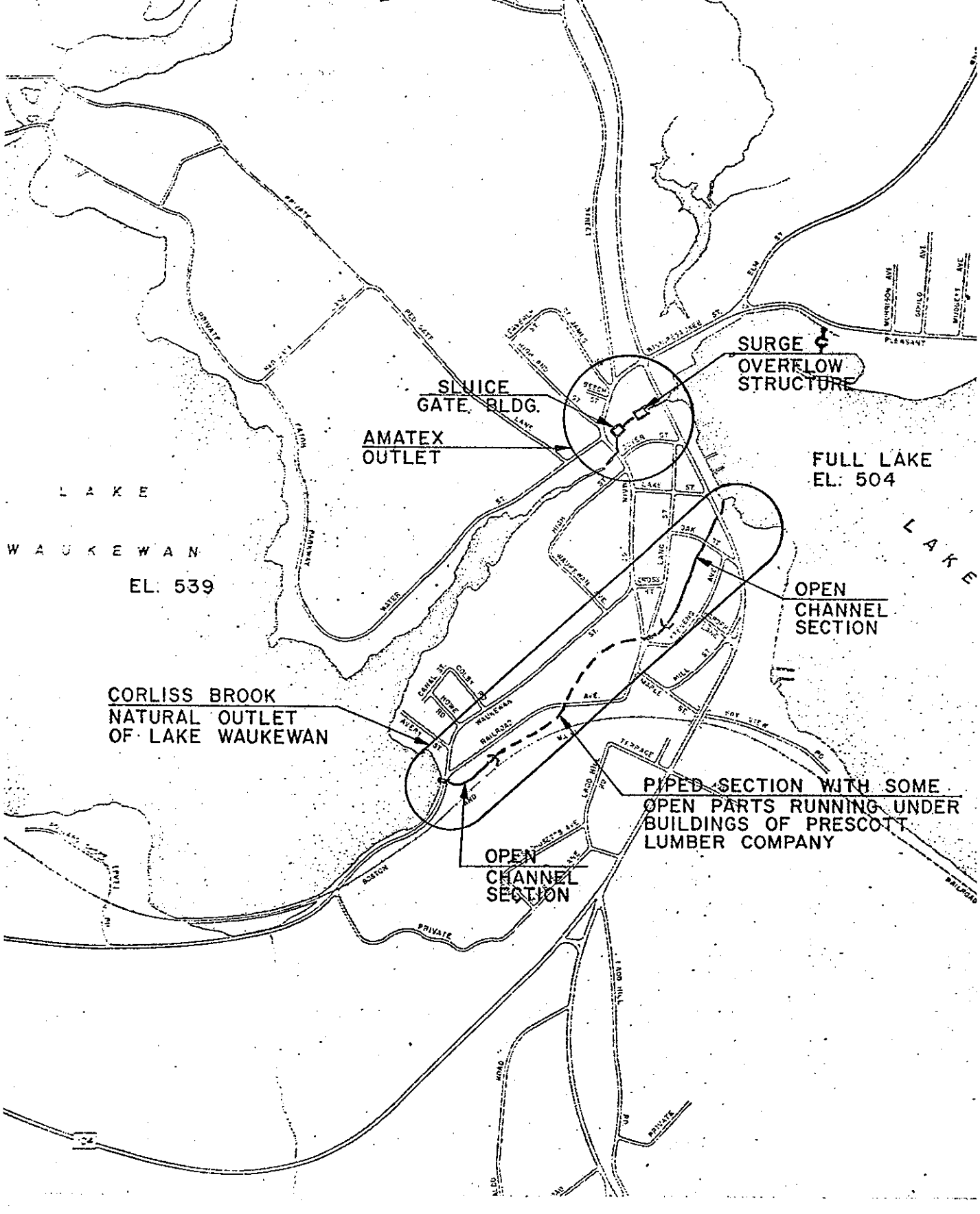
Photo 5 - The chute channel downstream of the surge and overflow structure (refer to overview photo). The total drop is about 35 feet.

Photo 6 - View of the outlet to Lake Winnepesaukee. The culvert runs under U.S. Route 3 and the Amatex Corporation mill building in the background.

APPENDIX C

PLATES

PLANS & DETAILS OF DAM	Drawings 1 & 2
GEOLOGIC MAP	Drawing 3



HARRIS - ECI ASSOCIATES	
LAKE WAUKEWAN LAKE OUTLET	DWG. 1

STEEL SUPPORT

STOP PLANKS 7½" HIGH; 3 IN PLACE ON 6/5/73
MAXIMUM NUMBER : 4

3'-9"

W.L. ON 6/5/73 EL. 539.6 ±

TOP OF FIXED CONCRETE CREST
ELEV. 537.20 (ESTIM.)

TRAINING WALL

GROUND LEVEL

SECT. A-A

TOP OF STEEP SLOPE

BOTTOM OF SLOPE

AMATEX MILL BLDG

AMATEX MILL BUILDING

GATE HOUSE

6 FT. DIA.

ABANDONED 6' PENSTOCK

TURBINE TAILRACE

CULVERT

SURGE & OVERFLOW STRUCTURE

OUTLET CHUTE CHANNEL

TRAINING WALL

TURBINE ROOM (NOT IN USE)

BOTTOM OF SLOPE

US ROUTE 3

LAKE WINNEPESAUKE FULL LAKE ELEV. 504.2

TRASH RACK INTAKE

2 STY BLDG

ALLEY

6'x6' CONCRETE BOX CULVERT ?

6 FT. DIA. PENSTOCK

20'

1 STORY BLDG

CANAL FROM LAKE WAUKEWAN

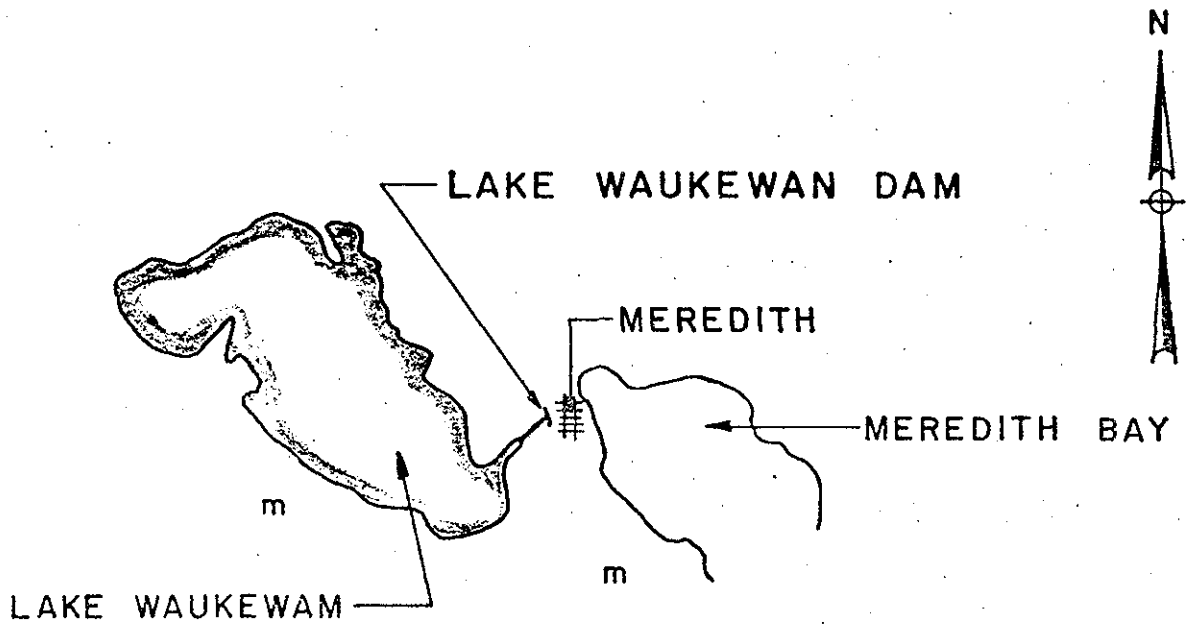
WATER LEVEL EL. 539 ±

MAIN STREET

DOVER ST.

SWAZEY'S MONUMENT

HARRIS-ECI ASSOCIATES	
LAKE WAUKEWAN DAM	DWG.
FIELD INSPECTION SKETCH	2



Scale: 1" = 1 Mile

LEGEND:

m Ground Moraine (Till)

—— Contact

NOTES:
1. No Outcrops Observed in Vicinity of Dam
2. Bedrock is a Porphyritic Granitic Gneiss and is Mantled by a Veneer of Moraine

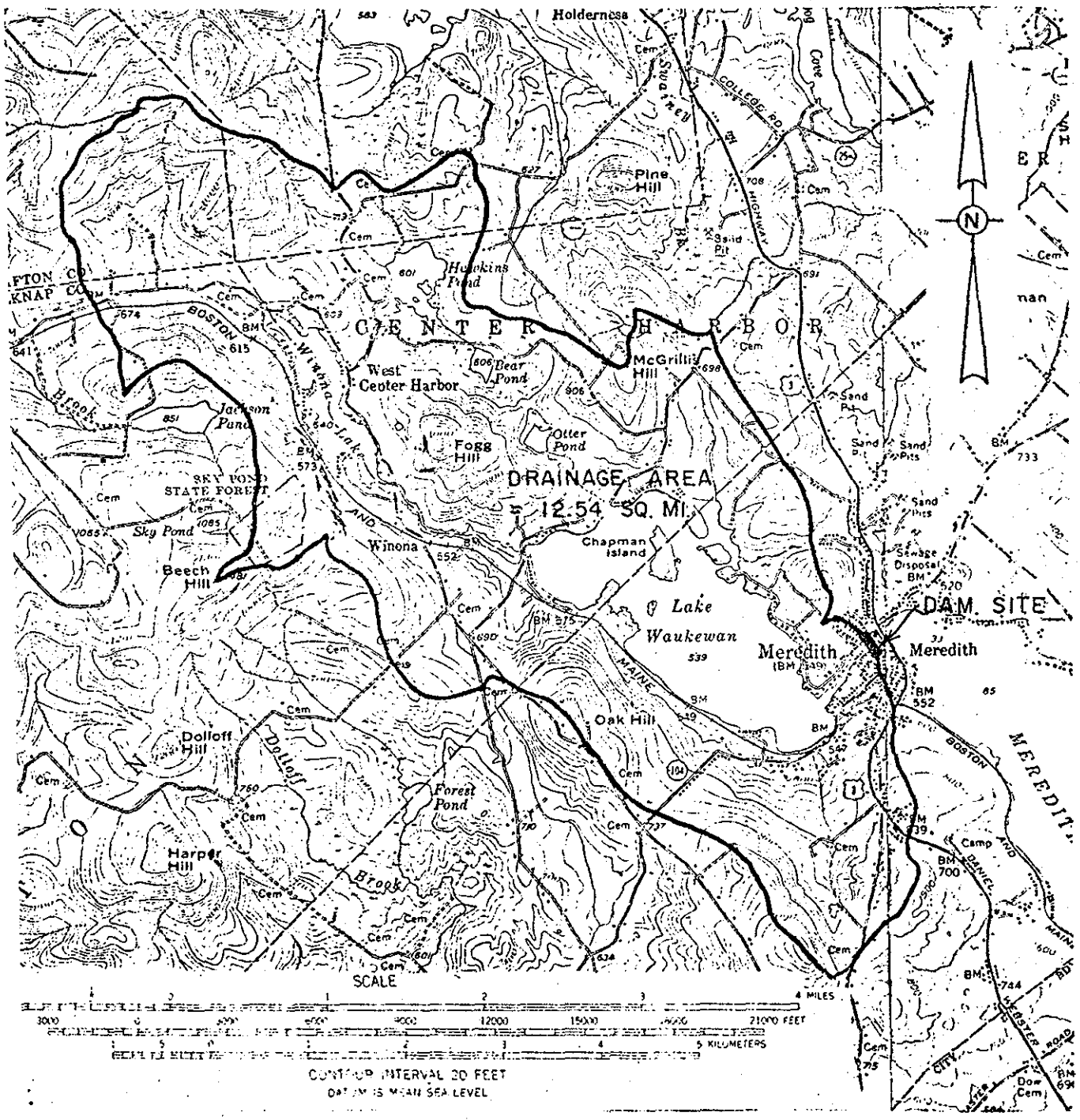
GEOLOGIC MAP

LAKE WAUKEWAN DAM

DWG. NO. 3

APPENDIX D

HYDROLOGIC COMPUTATIONS



LAKE WAUKEWAN DAM
DRAINAGE BASIN

EW HAMPSHIRE DAM SAFETY INSPECTION SHEET NO. ____ OF ____
LAKE WAUKEWAN DAM JOB NO. ____
ESERVOIR AREA CAPACITY DATA BY ____ DATE ____

WAUKEWAN LAKE DAM

RESERVOIR AREA CAPACITY DATA

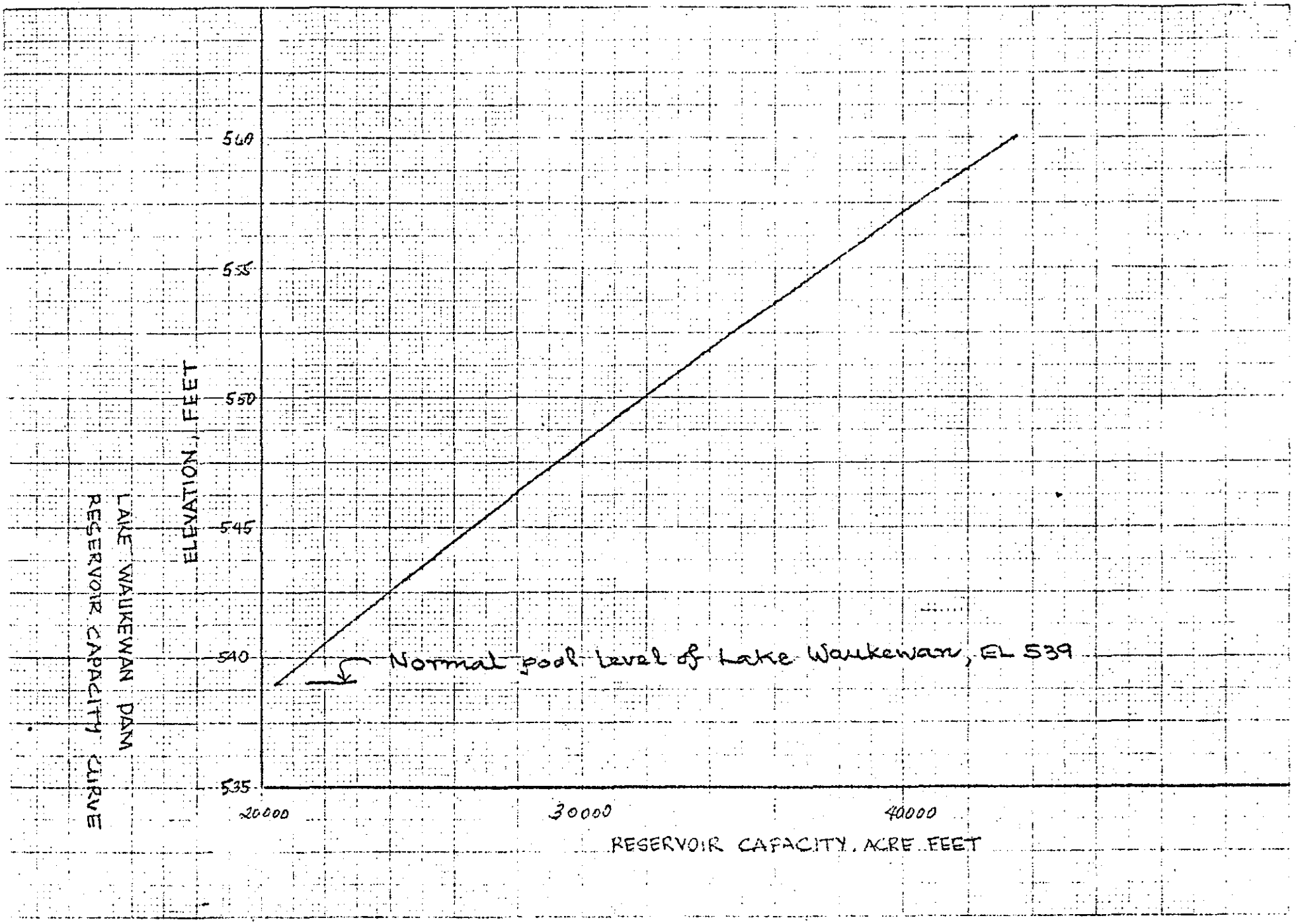
MAXIMUM STORAGE = 24,500 AF EL = 543.06 Ft

NORMAL STORAGE = 20542 AF EL = 539 Ft

RESERVOIR SURFACE AREA = 947.2 Acres

AT AN ELEV OF 539 Ft

ELEVATION FT	RESERVOIR AREA ACRES	RESERVOIR VOLUME AC-FT	REMARKS
539	947.2	20542	
543	1002	24440	
543.06	1003	24500	
543.08	1003	24520	
560	1225	43453	


LAKE WAUKEWAN DAM
RESERVOIR CAPACITY CURVE
ELEVATION, FEET
560
555
550
545
540
535
20000
30000
40000
RESERVOIR CAPACITY, ACRE FEET
Normal pool level of Lake Waukewan, EL 539

ENGINEERING CONSULTANTS, INC.

NEW HAMPSHIRE DAM SAFETY INSPECTION — SHEET NO. 1 OF
LAKE WAUKEWAN DAM — JOB NO. 1211-001
RADP RATING CURVE — BY MAB DATE 8/10/

LAKE WAUKEWAN DAM

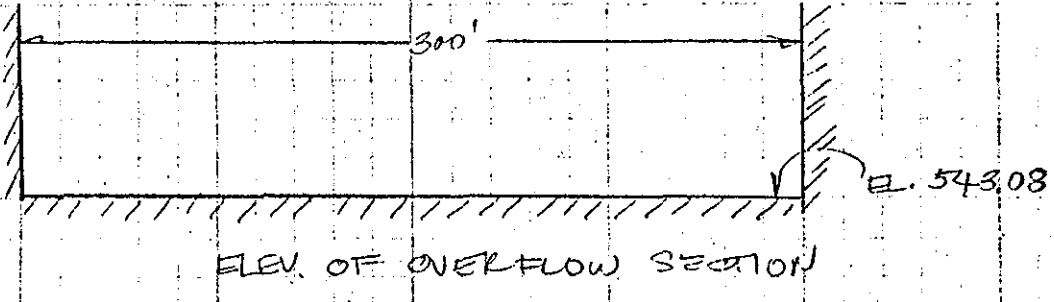
OVERTOP RATING CURVE

ASSUME THE FOLLOWING

1. An overflow section of 300' long
2. Assume $C = 3.03$ in the formula

$$Q = CLH^{3/2}$$

3. Assume top of overflow section at 543.08



ELEV. OF OVERFLOW SECTION

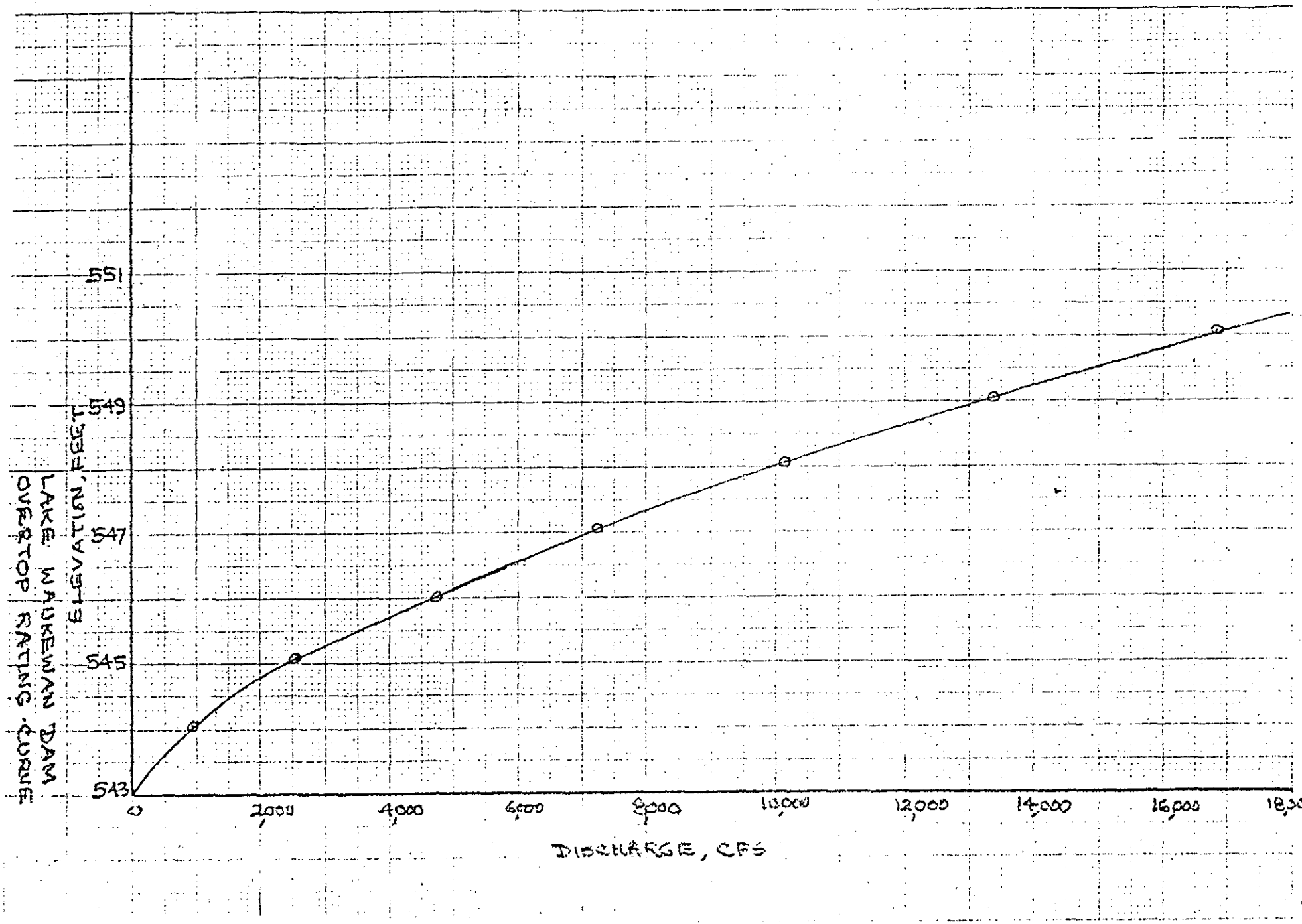
ECI-4 ENGINEERING CONSULTANTS, INC.

HILL HAMPSHIRE DAM SAFETY INSPECTION SHEET NO. 2 OF

LAKE WAUKEWAN DAM JOB NO. 1211-00

OVERFLOW RATING CURVE BY RMAS DATE 8

ELEV. FEET	HEAD ON OVERFLOW SECTION	H	C	L	$Q = CLH^{3/2}$
543.08	0	0			0
544.08	1	1	3.03	300	909
545.08	2	2	3.03	300	2571
546.08	3	3	3.03	300	4725
547.08	4	4	3.03	300	7272
548.08	5	5	3.03	300	10163
549.08	6	6	3.03	300	13360
550.11	7	7	3.03	300	16855
551.08	8	8	3.03	300	20572
552.08	9	9	3.03	300	24545


LAKE WAUKEWAN DAM
OVERTOP RATING CURVE
ELEVATION, FEET
551
549
547
545
543
0
2000
4000
6000
8000
10,000
12,000
14,000
16,000
18,300
DISCHARGE, CFS

LAKE WAUKEWAUN DAM

MAXIMUM PROBABLE FLOOD PEAK FLOW RATE

ACCORDING TO NED GENERAL CURVE:

ASSUME ROLLING AREA:

$Q = 2323 - 676.99 \log_{10} A$

$A = 12.54$ SQ. MI.

$\therefore Q = 1579.46$ CFS / SQ. MI.

$Q_p = A \times Q = 12.54 \times 1579.46 \simeq \underline{19806 \text{ CFS}}$

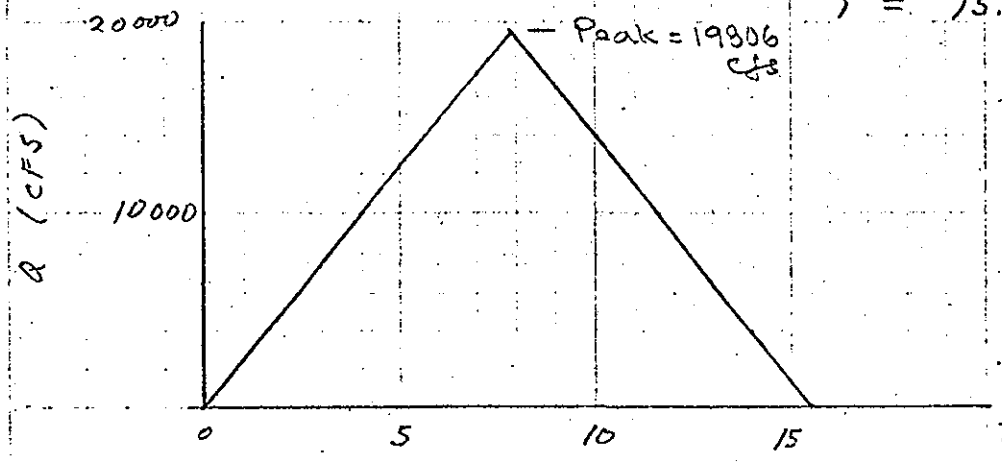
SINCE PMF RUNOFF IN NEW ENGLAND EQUALS APPROXIMATELY 19 INCHES ACCORDING TO NED GUIDLINES.

THE TRIANGULAR SHAPED HYDROGRAPH WILL BE APPROXIMATED BY THE FOLLOWING SHAPE:

$\frac{1}{2} T \times Q_p = 19'' \times A$

$\therefore T = 2\left[\left(\frac{19}{12}\right) \times 12.54 \times 5280^2\right] / [3600 \times 19806]$

$T = 15.53$ HR



HEC 1 - COMPUTATIONS

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - NEW HAMPSHIRE SHEET NO. 1 OF
LAKE WAUKEWAUN DAM JOB NO. 211-001-1
INPUT TO HEC-1 BY KLB DATE 8-

INPUT TO HEC-1

#	ELEV (FT)	HEAD ABOVE OVERFLOW SECTION (FT)	Y2 STORAGE (AC-FT)	Y3 DISCHARGE (CFS)
1	539.0 (NORMAL POOL)	—	20500	0.0
2	541.0	—	22450	0.0
3	543.08 (OVER FLOW SEC.)	0.	24200	0.0
4	543.25	0.17	24500	64.0
5	543.50	0.42	24950	247.0
6	544.00	0.92	25500	802.0
7	545.00	1.92	26550	2418.0
8	546.00	2.92	27650	4536.0
9	548.00	4.92	30300	9920.0
10	550.00	6.92	31900.0	16547.0

****
HEC-1 VERSION DATED JAN 1973
****

DAM SAFETY INSPECTION - NEW HAMPSHIRE
LAKE WAUKEWAN DAM
PMF FLOOD ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	15	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT TRIANGULAR SHAPED HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
4	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	12.54	0.00	12.54	0.00	0.000	0	0	0

INPUT HYDROGRAPH

0.	639.	1278.	1917.	2556.	3195.	3833.	4472.	5111.	5750.
6389.	7028.	7667.	8306.	8945.	9584.	10222.	10861.	11500.	12139.
12778.	13417.	14506.	14695.	15334.	15973.	16611.	17250.	17889.	18258.
19167.	19806.	19167.	18258.	17889.	17250.	16611.	15973.	15334.	14695.
14056.	13417.	12778.	12139.	11500.	10861.	10222.	9584.	8945.	8306.
7667.	7028.	6389.	5750.	5111.	4472.	3833.	3195.	2556.	1917.
1278.	639.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19806.	15968.	6394.	4092.	613896.
INCHES		11.84	18.97	18.97	18.97
AC-FT		7922.	12690.	12690.	12690.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH LAKE WAUKEWAN DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
4	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	20500.	22450.	24200.	24500.	24950.	25500.	26550.	27650.	30300.	31900.
OUTFLOW=	0.	0.	0.	64.	247.	802.	2418.	4356.	9920.	16547.

TIME	END STOR	AVG IN	END OUT
1	22450.	0.	0.
2	22456.	319.	0.
3	22476.	958.	0.
4	22509.	1597.	0.
5	22555.	2236.	0.
6	22615.	2875.	0.
7	22687.	3514.	0.
8	22773.	4152.	0.
9	22872.	4791.	0.
10	22984.	5430.	0.
11	23110.	6069.	0.
12	23248.	6708.	0.
13	23400.	7347.	0.
14	23565.	7986.	0.
15	23743.	8625.	0.
16	23935.	9264.	0.
17	24139.	9903.	0.
18	24357.	10541.	33.
19	24586.	11180.	99.
20	24827.	11819.	197.
21	25079.	12458.	377.
22	25339.	13097.	640.
23	25611.	13961.	973.
24	25888.	14600.	1399.
25	26165.	15014.	1825.
26	26446.	15653.	2258.
27	26731.	16292.	2737.
28	27019.	16930.	3245.
29	27310.	17569.	3757.
30	27600.	18073.	4269.
31	27892.	18712.	4866.
32	28188.	19486.	5486.
33	28471.	19486.	6081.
34	28727.	18712.	6617.
35	28958.	18073.	7103.
36	29170.	17569.	7548.
37	29360.	16930.	7946.
38	29528.	16292.	8300.
39	29677.	15653.	8613.
40	29807.	15014.	8884.
41	29918.	14375.	9110.
42	30011.	13736.	9314.
43	30087.	13097.	9474.
44	30148.	12458.	9601.
45	30193.	11819.	9695.
46	30223.	11180.	9758.

47	30259.	10541.	9791.
48	30241.	9903.	9796.
49	30230.	9264.	9774.
50	30207.	8625.	9725.
51	30172.	7986.	9651.
52	30125.	7347.	9553.
53	30067.	6708.	9432.
54	29999.	6069.	9289.
55	29921.	5430.	9126.
56	29834.	4791.	8942.
57	29737.	4152.	8738.
58	29631.	3514.	8516.
59	29517.	2875.	8277.
60	29395.	2236.	8020.
61	29265.	1597.	7748.
62	29128.	958.	7459.
63	28983.	319.	7156.
64	28839.	0.	6852.
65	28700.	0.	6561.
66	28567.	0.	6283.
67	28440.	0.	6016.
68	28319.	0.	5760.
69	28202.	0.	5516.
70	28091.	0.	5282.
71	27984.	0.	5057.
72	27881.	0.	4843.
73	27784.	0.	4637.
74	27690.	0.	4440.
75	27600.	0.	4256.
76	27513.	0.	4115.
77	27430.	0.	3968.
78	27349.	0.	3826.
79	27271.	0.	3689.
80	27197.	0.	3558.
81	27124.	0.	3430.
82	27055.	0.	3308.
83	26988.	0.	3189.
84	26923.	0.	3075.
85	26860.	0.	2965.
86	26800.	0.	2859.
87	26742.	0.	2757.
88	26686.	0.	2658.
89	26632.	0.	2563.
90	26580.	0.	2472.
91	26530.	0.	2388.
92	26482.	0.	2313.
93	26434.	0.	2240.
94	26389.	0.	2170.
95	26345.	0.	2102.
96	26302.	0.	2037.
97	26261.	0.	1973.
98	26220.	0.	1911.
99	26182.	0.	1851.
100	26144.	0.	1793.
101	26107.	0.	1737.
102	26072.	0.	1683.
103	26038.	0.	1630.
104	26005.	0.	1579.
105	25973.	0.	1529.
106	25941.	0.	1482.
107	25911.	0.	1435.

108	25882.	0.	1390.
109	25854.	0.	1347.
110	25826.	0.	1305.
111	25800.	0.	1264.
112	25774.	0.	1224.
113	25749.	0.	1186.
114	25725.	0.	1149.
115	25702.	0.	1113.
116	25679.	0.	1078.
117	25657.	0.	1044.
118	25636.	0.	1011.
119	25615.	0.	980.
120	25595.	0.	949.
121	25576.	0.	919.
122	25557.	0.	890.
123	25539.	0.	863.
124	25522.	0.	836.
125	25505.	0.	809.
126	25488.	0.	790.
127	25472.	0.	774.
128	25456.	0.	758.
129	25441.	0.	742.
130	25425.	0.	727.
131	25411.	0.	712.
132	25396.	0.	697.
133	25382.	0.	683.
134	25368.	0.	669.
135	25354.	0.	655.
136	25341.	0.	641.
137	25328.	0.	628.
138	25315.	0.	615.
139	25302.	0.	602.
140	25290.	0.	590.
141	25278.	0.	578.
142	25266.	0.	566.
143	25254.	0.	554.
144	25243.	0.	543.
145	25232.	0.	531.
146	25221.	0.	520.
147	25210.	0.	510.
148	25200.	0.	499.
149	25190.	0.	489.
150	25180.	0.	479.
SUM			481976.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9796.	9139.	4779.	3213.	481976.
INCHES		6.77	14.18	14.89	14.89
AC-FT		4534.	9484.	9963.	9963.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	4	19806.	15968.	6394.	4092.	12.54
ROUTED TO	4	9796.	9139.	4779.	3213.	12.54

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
NH	306	NED	NH	001	01				LAKE WAUKEWAN DAM	4339.3	7130.1	15DEC78

POPULAR NAME	NAME OF IMPOUNDMENT
	LAKE WAUKEWAN

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	05	TR-LAKE WINNIPESAUKEE	MEREDITH	0	2904

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE–FT.)
PGOT	1904	RS			24500	20542

DIST OWN FED R PRV/FED SCS A VER/DATE

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1		C	11	530												

OWNER	ENGINEERING BY	CONSTRUCTION BY
AMTEX CORP		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
HARRIS-ECI ASSOCIATES	06JUN78	PL 92-367

REMARKS
30-NO ACTUAL DAM